

Patent

Attorney Docket No.: 2855/110

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**RECEIVED**
CENTRAL FAX CENTER
JUL 31 2006

APPLICANT : Xiaofang ZHANG et al.
SERIAL NO. : 10/775,658
FILED : February 9, 2004
FOR : ELECTRICAL CURRENT MEASUREMENTS AT
HEAD-DISK INTERFACE
GROUP ART UNIT : 2627
EXAMINER : Varsha A. KAPADIA
CUSTOMER NO. : 25693

VIA FACSIMILE

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Commissioner for Patents
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Alexandria, VA 22313-1450 on

Dated: July 31, 2006

Signature

Barbara Vance
Barbara Vance**ATTENTION: Board of Patent Appeals and Interferences****APPEAL BRIEF**

This brief is in furtherance of the Notice of Appeal, filed in this case on March 30, 2006.

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1. **REAL PARTY IN INTEREST**

The real party in interest in this matter is SAE Magnetics (H.K.) Ltd. (Assignment recorded February 9, 2004, Reel/Frame 014983/0450).

2. **RELATED APPEALS AND INTERFERENCES**

There are no related appeals.

3. **STATUS OF THE CLAIMS**

Claims 1-17 are pending in this application. Claims 1-5, 7-8, 9-11 and 13-17 are rejected under 35 U.S.C. §102(b) as being anticipated by Kakekado et al. (USPN 6,359,746), hereinafter ("Kakekado"). Claims 6 and 12 are rejected under 35 U.S.C. §103(a) as being unpatentable over Kakekado in view of Hampshire (USPN 5,329,409).

4. **STATUS OF AMENDMENTS**

The claims listed starting on page A-1 of the Appendix attached to this Appeal Brief reflect the present status of the claims.

5. **SUMMARY OF THE CLAIMED SUBJECT MATTER**

Claim 1 describes an apparatus, comprising a current measurement device (*see e.g.*, Specification, paragraph [0027] – Figure 3 -- 309); a head gimbal assembly including a head to at least one of read and write information signals (*see e.g.*, Specification, paragraph [0026] – Figure 3) from/to a moving storage medium (*see e.g.*, Specification, paragraph [0027] – Figure 3 -- 303), the current measurement device electrically coupled to the head and the storage

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medium (*see e.g.*, Specification, paragraph [0026]; and the current measurement device is to measure current between the head and the storage medium (*see e.g.*, Specification, paragraph [0027]).

Claim 3 describes an apparatus to measure contact between a magnetic recording head and a storage medium, comprising a current measurement device (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 309**); a head gimbal assembly including a magnetic recording head (*see e.g.*, Specification, paragraph [0026] – **Figure 3**), the recording head electrically coupled to the current measurement device; and a storage medium coupled to the current measurement device (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 303**); and the current measurement device to measure current between the magnetic recording head and the storage medium (*see e.g.*, Specification, paragraph [0027]).

Claim 9 describes a method of measuring current, comprising coupling a current measurement device (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 309**) to a head of a head gimbal assembly (*see e.g.*, Specification, paragraph [0026] – **Figure 3**), the head to at least one of read and write information signals from/to a moving storage medium (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 303**); coupling the current measurement device to the storage medium; and measuring current between the head and the storage medium with the current measurement device (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 309**).

Claim 15 describes a method of determining flying height characteristics for a disk drive comprising coupling a current measurement device (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 309**) to a head of a head gimbal assembly (*see e.g.*, Specification, paragraph [0026] – **Figure 3**), the head to at least one of read and write information signals from/to a moving storage

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medium (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 303**); coupling the current measurement device to a the storage medium (*see e.g.*, Specification, paragraph [0027] **Figure 3 – 309**); measuring current between the head and the storage medium with the current measurement device (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 309**); and determining that the head has too low of a flying height based on the current measurement (*see e.g.*, Specification, paragraph [0029]).

Claim 16 describes a method of determining glide height characteristics for a disk drive comprising coupling a current measurement device (*see e.g.*, Specification, paragraph [0027] **Figure 3 – 309**) to a glide head of a head gimbal assembly (*see e.g.*, Specification, paragraph [0026] – **Figure 3**); coupling the current measurement device to a the storage medium (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 303**); measuring current between the head and the storage medium with the current measurement device; and determining presence of disk asperities based on the current measurement (*see e.g.*, Specification, paragraph [0029]).

Claim 17 describes a method of controlling flying height of a magnetic head in a disk drive comprising coupling an ammeter/voltage source (*see e.g.*, Specification, paragraph [0027] **Figure 3 – 309**) to the magnetic head of a head gimbal assembly (*see e.g.*, Specification, paragraph [0026] – **Figure 3**); coupling the ammeter/voltage source to a rotating magnetic storage medium (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 303**); applying voltage to the magnetic head; measuring current between the head and the storage medium with the ammeter/voltage source (*see e.g.*, Specification, paragraph [0027] – **Figure 3 – 309**); and adjusting an amount of applied voltage to the magnetic head based on the measure current (*see e.g.*, Specification, paragraph [0029]).

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According to an embodiment of the present invention, electrical current is measured at the interface between the magnetic head slider and the magnetic medium. The presence of current between the medium (e.g., a magnetic recording disk) and the head slider is due to the presence of charge on the slider and disk and a discharge takes place during contact between the two. Such a current may also be due to triboelectric charge and discharge due to a head-disk contact event. This discharge current is very low and can be on the order of microamps or nanoamps. The measurement of the electrical current between the medium and the slider-head provides an accurate assessment of slider/disk contact events allowing the determination of the true glide or glide avalanche point of a disk and to identify magnetic head sliders that are contaminated (e.g., debris on the air bearing surface) are have flying heights that are too low for efficient operation. **FIGURE 1** is a perspective view of a flying slider with a read and write element assembly having a tapered conventional catamaran air bearing slider configuration. **FIGURE 2** is a plan view of a mounted air bearing slider over a moving magnetic storage medium. **FIGURE 3** is a block diagram of a system for measuring electric current between a magnetic head and a magnetic recording medium according to an embodiment of the present invention. **FIGURE 4** is a graph comparing HDI current measurement according to an embodiment of the present invention with acoustical energy measurement of the prior art. **FIGURE 5** is a graph comparing a PW50 signal from a slider/head and a HDI current measurement for the slider/head according to an embodiment of the present invention. **FIGURE 6** is a graph comparing HDI current measurement according to an embodiment of the present invention with acoustical energy measurement of the prior art.

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6. GROUND OF REJECTION TO BE REVIEWED ON APPEAL

A. Claims 1-5, 7-8, 9-11 and 13-17 are rejected under 35 U.S.C. §102(b) as being anticipated by Kakekado et al. (USPN 6,359,746), hereinafter ("Kakekado").

B. Claims 6 and 12 are rejected under 35 U.S.C. §103(a) as being unpatentable over Kakekado in view of Hampshire (USPN 5,329,409).

7. ARGUMENT

A. Claims 1-5, 7-8, 9-11 and 13-17 are not anticipated under 35 U.S.C. 102(b) as being anticipated by Kakekado.

Applicants respectfully submit the cited references do not teach, suggest or disclose "[a]n apparatus, comprising: *a current measurement device*; a head gimbal assembly including a head to at least one of read and write information signals from/to a moving storage medium, *said current measurement device electrically coupled* to said head and said storage medium; and said current measurement device is to *measure current* between said head and said storage medium" (e.g., as described in claim 1) (emphasis supplied).

As to claim 1, the Examiner asserts Col. 7 lines 19-21 and 23-37 of Kakekado shows the recited current measurement device. See Office Action dated 12/30/2005, page 2, paragraph 2.

Applicants disagree. The cited section states:

The magnetic head includes a magnetic head for recording/reproducing information while in contact with the surface of the magnetic disk, and the control means includes means for controlling the potential difference between the magnetic disk and the magnetic head slider applied by the *voltage application means* and stabilizing the state of the magnetic head slider in contact with the magnetic disk on the basis of the detection result of the detection means. (*emphasis added*)

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Therefore, the cited section describes that a *voltage application means* is provided to *apply voltage* so as to control the voltage potential difference between the magnetic disk and the magnetic head slider. Though current and voltage can be directly proportional, a voltage application means cannot be considered a current measurement device. It is noted that Figs. 15 and 21-22 all refer to a voltage generating circuit 108 as an example of the voltage application means. The text cited by the Examiner also refers to a "detection means." See Office Action dated 12/30/2005 column 6, line 46. However, as seen in Col. 7, lines 6-11, the detection means includes an *acceleration* detector and some sort of detection for the *roughness* of the magnetic disk. Nowhere in Kakekado does it suggest that such detection means could be used as a current measurement device or a voltage measurement device.

The Examiner further asserts that the reference teaches a detection means for potential difference detection, and hence a change in voltage as well as in current is occurring and is being detected (citing columns 6-7). See Office Action dated 12/30/2005, page 6, paragraph 6 and Advisory Action dated 5/2/2006, page 2. Applicants again disagree, and submit that the cited reference does not teach a *detection* means for potential difference (as asserted by the Examiner), but rather a potential difference *application* device. As argued above, *application* is not the equivalent *detection*, and application certainly does not equal *measurement*. Kakekado does not teach or describe voltage detection or measurement. Moreover, Applicants submit that nowhere in the extensive cited section of "columns 6-7" is the description of the use of a detection means or a measurement means for *current*. The Examiner's assertion that a change in voltage as well as in current is occurring *and is being detected* is erroneous and unsupported by the Kakekado reference.

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In the same paragraph, the Examiner directs Applicants to reference numeral 108 and its disclosure. As argued above, Kakekado does not describe the “voltage *generating* circuit” 108 (*emphasis added*) as having the ability to *measure* voltage, and element 108 definitely is not the equivalent of a “current measurement device” as specifically recited in claimed embodiments of the present application.

Along with the assertion *measurement* of current can be obtained by a voltage *application* means, the Examiner points to Applicants’ claim 7 alleging it refers to the voltage source as the current measurement device. *See* Advisory Action dated 5/2/2006, page 2. The Examiner’s mischaracterization of claim 7 is improper. Claim 7 specifically includes a reference to an “ammeter”, known those of ordinary skill in the art as a current *measurement* device. Applicants maintain a current measurement device such as an ammeter as described in the embodiment of claim 7 is different from a voltage *application* device.

In order to support a proper §102(b) rejection, the Kakekado reference must describe each and every limitation of claim 1, including at least a “current measure device”. Since it does not, Applicants submit that the Kakekado reference is inadequate to support a proper §102(b) rejection, and the rejection of claim 1 should be withdrawn.

B. Claims 6 and 12 are not rendered obvious under 35 U.S.C. §103(a) as being unpatentable over Kakekado in view of Hampshire.

Hampshire does not make up for the deficiencies of Kakekado in that Hampshire is concerned with compensating for offset in the actuator current of the servo system of a disc

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drive. Hampshire discloses the sensing of actuator current and has nothing at all to do with sensing current between a head and a storage medium as recited in the claims.

Therefore, since none of the cited references teach, suggest or describe each and every limitation of claim 1, the current rejection is inadequate and should be withdrawn, and claim 1 should be allowed. Independent claims 3, 9 and 15-17 contain similar allowable subject matter, and therefore are allowable as well. Claims 2, 4-8 and 9-14 are allowable for depending from allowable base claims.

Appellants therefore respectfully request the Board of Patent Appeals and Interferences reverse the Examiner's decision rejecting claims 1-8, 10-12, 14-23 and 25-30 and direct the Examiner to pass the case to issue.

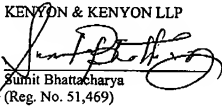
The Examiner is hereby authorized to charge the appeal brief fee of \$500.00 and any additional fees which may be necessary for consideration of this paper to Kenyon & Kenyon Deposit Account No. 11-0600.

Respectfully submitted,

KENYON & KENYON LLP

Date: July 31, 2006

By:


Sumit Bhattacharya
(Reg. No. 51,469)

KENYON & KENYON LLP
333 West San Carlos St., Suite 600
San Jose, CA 95110

Telephone: (408) 975-7500
Facsimile: (408) 975-7501

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APPENDIX

(Brief of Appellants Xiaofeng Zhang et al.
U.S. Patent Application Serial No. 10/775,658)

8. CLAIMS ON APPEAL

1. An apparatus, comprising:

a current measurement device;

a head gimbal assembly including a head to at least one of read and write information signals from/to a moving storage medium, said current measurement device electrically coupled to said head and said storage medium; and

said current measurement device is to measure current between said head and said storage medium.

2. The apparatus of claim 1 wherein said head is a magnetic head/slider.

3. An apparatus to measure contact between a magnetic recording head and a storage medium, comprising:

a current measurement device;

a head gimbal assembly including a magnetic recording head, said recording head electrically coupled to said current measurement device; and

a storage medium coupled to said current measurement device; and

said current measurement device to measure current between said magnetic recording head and said storage medium.

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4. The apparatus of claim 3 wherein said storage medium is a rotating magnetic storage disk.
5. The apparatus of claim 4 wherein said magnetic storage disk is coupled to a spindle and said spindle is coupled to said current measurement device.
6. The apparatus of claim 5 wherein said current measurement device is a current amplifier.
7. The apparatus of claim 5 wherein said current measurement device is an ammeter/voltage source.
8. The apparatus of claim 7 wherein said ammeter/voltage source is to supply voltage to said magnetic recording head.
9. A method of measuring current, comprising:
 - coupling a current measurement device to a head of a head gimbal assembly, said head to at least one of read and write information signals from/to a moving storage medium;
 - coupling said current measurement device to a said storage medium; and
 - measuring current between said head and said storage medium with said current measurement device.

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10. The method of claim 9 wherein said head is a magnetic recording head/slider and said storage medium is a magnetic storage disk.
11. The method of claim 10 wherein said magnetic storage disk is coupled to a spindle and said current measurement device is coupled to said spindle.
12. The method of claim 11 wherein said current measurement device is a current amplifier.
13. The method of claim 11 wherein said current measurement device is an ammeter/voltage source.
14. The method of claim 13 further comprising:
applying voltage to said magnetic recording head with said ammeter/voltage source.
15. A method of determining flying height characteristics for a disk drive comprising:
coupling a current measurement device to a head of a head gimbal assembly, said head to at least one of read and write information signals from/to a moving storage medium;
coupling said current measurement device to a said storage medium;
measuring current between said head and said storage medium with said current measurement device; and
determining that said head has too low of a flying height based on said current measurement.

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16. A method of determining glide height characteristics for a disk drive comprising:
- coupling a current measurement device to a glide head of a head gimbal assembly;
 - coupling said current measurement device to a said storage medium;
 - measuring current between said head and said storage medium with said current measurement device; and
 - determining presence of disk asperities based on said current measurement.
17. A method of controlling flying height of a magnetic head in a disk drive comprising:
- coupling an ammeter/voltage source to the magnetic head of a head gimbal assembly;
 - coupling said ammeter/voltage source to a rotating magnetic storage medium;
 - applying voltage to said magnetic head;
 - measuring current between said head and said storage medium with said ammeter/voltage source; and
 - adjusting an amount of applied voltage to said magnetic head based on said measure current.

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9. EVIDENCE APPENDIX

No further evidence has been submitted with this Appeal Brief.

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10. RELATED PROCEEDINGS APPENDIX

Per Section 2 above, there are no related proceedings to the present Appeal.